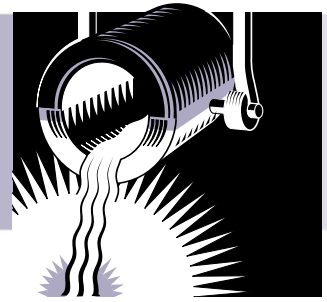


METAL CASTING

Project Fact Sheet



ADVANCED LOST FOAM CASTING

BENEFITS

Research findings have led to a greater understanding of the lost foam process. New process control measures are leading to improved analysis and control in each stage of the process. This is resulting in high quality castings, more cost and energy efficient foundry operations, and dramatic reductions in scrap. Specific accomplishments include:

- Developed non-contact air gauge for accurate dimensional analysis.
- Developed in-plant quality assurance procedures to measure coating parameters.
- Developed sand density gauge to measure the rate of sand compaction. Companion instrumentation measures casting distortion.
- Developed vibrational analysis instrumentation which, when coupled with the density gauge, allows the compaction cycle to be optimized to reduce compaction time and pattern distortion.

APPLICATIONS

The Lost Foam Casting Process is a breakthrough technology for producing components by eliminating cores and core boxes with improved dimensional control of casting wall thickness. Increased knowledge of, and control over, the process is resulting in rapid increases in aluminum and iron lost foam casting. The 1998 ASPE Award was made possible in part by the Lost Foam Casting manufacturing process.



NEW PROCESS CONTROL MEASURES AND TECHNICAL KNOWHOW LEADING TO ACCELERATED USE OF LOST FOAM PROCESS

Lost Foam Casting has significant cost and environmental advantages and enables metal casters to produce complex parts often not possible using other methods. The process allows designers to consolidate parts, reduce machining and minimize assembly operations. It also allows foundries to reduce solid waste and emissions. Research co-funded by the U.S. Department of Energy and an industry consortium, and being performed at the University of Alabama at Birmingham Lost Foam Technology Center, has resulted in significant improvements in lost foam process controls. These developments have been, and continue to be adapted for use in industry.

The lost foam process consists of first making a foam pattern having the geometry of the desired finished metal part. After a short stabilization period, the pattern is dipped into a water solution containing a suspended refractory. The refractory material coats the foam pattern leaving a thin heat resistant layer that is air dried. When drying is complete, the coated foam is suspended in a steel container that is vibrated while sand is added to surround the coated pattern. The sand provides mechanical support to the thin refractory layer. Molten metal is then poured into the mold, and the molten metal melts and vaporizes the foam. The solidified metal leaves a nearly exact replica of the pattern which is machined as required to produce the desired finished shape.

Proper controls must be exercised in each step of the process to assure consistent high quality castings. A lack of in-depth knowledge of the process necessary for proper control measures had slowed adoption of the lost foam casting process.

INCREASED OPPORTUNITIES FOR LOST FOAM



Aluminum transmission housing component with cast-in brass insert.

Project Description

Goal: In 1989 a consortium of foundries, suppliers, and academia joined the U.S. Department of Energy to research and improve the understanding of the lost foam process. Specific goals of this research, conducted through the Lost Foam Technology Center at the University of Alabama at Birmingham, have been to advance process control measures to produce high quality, high precision castings. The development and application of coating technology for the production of iron and aluminum castings was an early concern.

The consortium is the driving force behind technical improvements in the process. The efforts of the consortium are also resulting in rapidly growing markets for lost foam castings. An estimated 40,000 tons of lost foam aluminum castings were produced in 1994. This increased 25% to 50,000 tons in 1997. This is expected to increase 64% to 82,000 tons by the year 2000 -- resulting in an estimated rate of increase of 105% over the six year period. Even faster growth is expected for lost foam iron castings, increasing 100% between 1994 and 1997 from 20,000 tons to 40,000 tons, and then more than doubling to an estimated 85,000 tons in the year 2000. This brings a total increase of 325% for lost foam iron castings over the same six year period.

Progress and Milestones

- A single stage air gauging system was developed followed by a 30-channel commercial air gauge for rapid determination of pattern dimensions.
- Instruments and transducers were developed for measuring vibrational frequencies and amplitudes on compactor tables, on flasks, and in sand. Sand vibrational amplitude and direction is important in achieving efficient compaction.
- A distortion gauge was developed to determine when and under what conditions pattern distortion occurs during compaction.
- A fill gauge was developed that can be put in a pattern cavity to determine the conditions that optimize sand to flow and fill.
- Two types of compaction gauges were developed to measure sand density in pattern cavities during compaction.
- A procedure was developed to measure the liquid absorption characteristics of liquid pattern pyrolysis in castings.
- An instrument was developed to measure the gas permeability of pattern coatings. Gas permeability controls the flow of metal into the pattern cavity and has a dominant effect on casting surface quality.
- An apparatus was developed to measure parameters of pattern degradation products at casting temperatures.
- Training courses have been developed for in-plant training of Lost Foam production personnel.

These devices have been successfully applied in a variety of commercial foundries.



PROJECT PARTNERS

University of Alabama at Birmingham
Lost Foam Technology Center
Birmingham, AL

University of Missouri - Rolla
Rolla, MO

American Foundry Society
Des Plaines, IL

Lost Foam Casting Consortium Partners

Advanced Cast Products, Inc.; Alex City Casting;
Ashland Chemical Co.; Austin Associates; BMW
AG; Borden, Inc.; Carbo Ceramics; Citation Corp.;
Copeland Corp.; Delaware Machine; Flow Science;
Foseco-Morval Inc.; General Kinematics Corp.;
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